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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte YILU ZHANG, NIANNIAN TONG, MUTASIM A. SALMAN,
KEVIN R. BAINBRIDGE, and DAVID W. WALTERS

Appeal 2016-001880
Application 13/023,748
Technology Center 2800

Before JAMES C. HOUSEL, GEORGE C. BEST, and JEFFREY R. SNAY,
Administrative Patent Judges.

SNAY, *Administrative Patent Judge.*

DECISION ON APPEAL¹

Appellants² appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 1–20. We have jurisdiction under 35 U.S.C. § 6(b). We REVERSE.

¹ We refer to the Specification (“Spec.”) filed February 9, 2011, amended August 14, 2013; Final Office Action (“Final Act.”) dated March 27, 2015; Appellants’ Appeal Brief (“App. Br.”) dated July 30, 2015; Examiner’s Answer (“Ans.”) dated October 14, 2015; and Appellants’ Reply Brief (“Reply Br.”) dated November 23, 2015.

² Appellants identify GM Global Technology Operations, LLC, as the real party in interest. App. Br. 2.

BACKGROUND

The subject matter on appeal regards methods for determining a battery's state-of-charge ("SOC") based on an open circuit voltage ("OCV") which is estimated from voltage and temperature measurements obtained at different times prior to equilibrium in a non-charging state. Spec. ¶ 4. Claims 1 and 13—the only independent claims on appeal—are reproduced from the Claims Appendix of the Appeal Brief:

1. A method of determining a state-of-charge of a battery for a vehicle, the vehicle being in a charging state when the engine is operating and a non-charging state when the engine is not operating, the method comprising the steps of:
 - measuring a first battery voltage at a first predetermined time after battery charging is discontinued in the non-charging state;
 - measuring a first temperature of the battery coinciding with the first battery voltage;
 - measuring a second battery voltage at a second predetermined time after the first predetermined time with the vehicle in the non-charging state, the second predetermined time being greater than the first predetermined time;
 - measuring a second temperature of the battery coinciding with the second battery voltage;
 - calculating an average temperature based on the first temperature measurement and the second temperature measurement;
 - determining a fixed time constant based on the average temperature;
 - estimating an open circuit voltage as a function of the first voltage measurement, the second voltage measurement, and the fixed time constant; and
 - determining a state-of-charge of the battery based on the estimated open circuit voltage.

13. A system for determining a state-of-charge of a battery for a vehicle, the vehicle being in a charging state when the

engine is operating and a non-charging state when the engine is not operating, the system comprising:

a battery;

a voltmeter for measuring a first battery voltage at a first predetermined time after battery charging is discontinued in the non-charging state, and for measuring a second battery voltage at a second predetermined time after battery charging is discontinued, the second predetermined time being greater than the first predetermined time;

a temperature sensor for measuring a first temperature of the battery coinciding with the first battery voltage, and for measuring a second temperature of the battery coinciding with the second battery voltage; and

a control module for determining a fixed time constant as a function of the first and second temperature measurements, the control module estimating an open circuit voltage at equilibrium as a function of the first battery voltage, the second battery voltage, and the fixed time constant, wherein the control module determines a state-of-charge of the battery based on the estimated open circuit voltage.

REJECTIONS³

- I. Claims 1, 2, 5–16, and 18–20 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Zhang⁴ and Wortham.⁵
- II. Claims 3, 4, and 17 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Zhang, Wortham, and Iwane.⁶

³ Final Act. 3–22; Ans. 2. The Examiner rejects claims 4, 7, 8, 10–12, 14, 15, and 18–20 in the Final Office Action but, without explanation, omits these claims from those identified in the Answer as subject to rejection on Appeal. *Compare* Final Act. ¶¶ 6, 24, *with* Ans. 2. Because we reverse the Examiner’s rejections as to all claims, the above-noted inconsistency is without consequence.

⁴ US 2009/0157335 A1, published June 18, 2009 (“Zhang”).

⁵ US 8,203,305 B1, issued June 19, 2012 (“Wortham”).

⁶ US 7,899,631 B2, issued March 1, 2011 (“Iwane”).

DISCUSSION

A dispositive issue in this appeal is whether the Examiner's finding that Wortham teaches estimating an open circuit voltage as a function of first and second voltage measurements and a temperature dependent fixed time constant constitutes reversible error.⁷ Particularly, the Examiner finds that Zhang "does not disclose . . . estimating an open circuit voltage as a function of the first voltage measurement, the second voltage measurement, and the fixed time constant." Final Act. 4. Rather, Zhang discloses periodically *measuring* a battery's open circuit voltage via a voltage sensor, so that a change in the battery's state of charge over time may be determined and correlated to the battery's parasitic load. Zhang Abstract, ¶¶ 4, 12, 14. Accordingly, the Examiner's obviousness determination in Rejections I and II is premised on the finding that Wortham teaches *estimating* a battery's open circuit voltage from voltage and temperature measurements taken at different times. For the reasons stated in the Appeal Brief and below, we agree with Appellants that the Examiner's finding as to Wortham is not supported.

Like Zhang, Wortham discloses determining open circuit voltage at a given point in time by measuring battery terminal voltage. Wortham col. 7, ll. 23–26 ("The battery terminal voltage is monitored and converted to digital form by the ADC. That value is effectively input into a digital filter,

⁷ Compare Final Act. 4 ("**Wortham** does teach . . . estimating an open circuit voltage (**col. 10 lines 26 – 30**) as a function of the first voltage measurement, the second voltage measurement, and the fixed time constant (**col. 6 lines 63 – 66**)", with App. Br. 9 ("The limitation of an open circuit voltage determined as a function of the first voltage measurement, the second voltage measurement, and the fixed time constant is neither described nor suggested as alleged.")).

the output of which is the open circuit voltage OCV.”); *see also id.* col. 3, ll. 41–46. The Examiner cites column 6, lines 63–66, and column 10, lines 26–30 of Wortham. Final Act. 4. At the cited portion of column 6, Wortham states that a fixed time-constant may be used in connection with modeling capacitance over time. At the cited portion of column 10, Wortham provides a mathematical relationship involving open cell voltage and a single voltage value, “ V_{cell} ”, where V_{cell} represents the battery’s terminal voltage. *See* Wortham col. 8, ll. 49–50 (“ V_{cell} is the terminal voltage on the cell.”).

Nowhere in the cited portions of Wortham do we find evidence sufficient to support the Examiner’s finding that Wortham teaches estimating a battery’s open circuit voltage from voltage and temperature measurements taken at different times. As such, the Examiner has not set forth a factual basis sufficient to support a *prima facie* case of obviousness. For that reason, we cannot sustain the Examiner’s rejections.

DECISION

The Examiner’s decision rejecting claims 1–20 is reversed.

REVERSED